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ABSTRACT

The purpose of this study was to examine the attitudes of males and females at Clovis Community College towards math anxiety and to look for possible factors that could be used to assist in the assignment of students to various math classes. The subjects in the study were fifty male students and fifty female students. Subjects responded to a math anxiety survey form designed by the researcher to measure the degree of agreement or disagreement with statements related to math anxiety. The results of the study included the identification of factors at Clovis Community College that could be incorporated into the planning of teaching methods and possible curriculum change. Notable differences were detected in the attitudes of males and females concerning their perception of the effectiveness of their previous math teachers. Other factors were also examined, such as initial cause of the students' math anxiety. The levels of math anxiety among male and female students showed little difference. Multiple regression models were computed as possible tools for predicting math anxiety levels in students at the college. This was a case study and reflects only data gathered at Clovis Community College during the Spring 2000 term. (Contains 36 references.) (Author/ASK)

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Attitude Differences Between Male and Female Students At Clovis Community College

And Their Relationships To Math Anxiety: A Case Study

by

Richard Lane Hendershot

A Dissertation
Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Education

California Coast University
MAY, 2000

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Committee Chairperson

California Coast University

2000

Abstract of the Dissertation

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Richard Lane Hendershot

Doctor of Education

California Coast University

Santa Ana, California

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CHAPTER ONE

Introduction

Statement of the Problem

The problem of student placement in college mathematics classes has always been a concern for community colleges. The factors involved are many, but for the most part students are given a math placement test which only looks at computational ability; they are assigned a class based solely on the results of a test that usually lasts about an hour. Studies have shown that other factors need to be addressed in teaching methods used in math classes (Tobias, 1993) and that one of the major factors affecting success in mathematics is math anxiety.

Math anxiety has been called an illness that is an emotional and cognitive dread of mathematics. (Hodges, 1983; Tobias, 1993). Some studies have shown that math anxiety can be transferred from parent to child (Zaslasvky, 1999). The problem to be addressed was whether or not studying the attitudes of students with surveys or other instruments should be incorporated into the placement of math students upon entering the community college. This study included attitude surveys which could possibly reflect the potential for success or failure in a specific math class.

Mathematics has been undergoing major reforms due to the high degree of unrest with mathematics education and the past results of mathematics teaching. The community colleges are in the position to develop new courses to cope with the influx of students who have difficulty with mathematics. Clovis Community College, the site of

this study, has been developing a new course below the present lowest level class because of the high failure rate of incoming math students in their first year. This study provided possible insight into some of the factors involved with this problem. It is possible that the students who are experiencing math difficulty are not being prepared in the high schools, but there are also other possible factors that could be connected with the college itself. This study looked at various factors along with past research and used quantitative methods to draw possible inferences about solutions to the problem. The purpose of the study was to help the students and the college. It was thought that this type research could contribute to program revision in a positive way since research can be used to dispel myths that may exist about this particular college.

The reform of mathematics education requires that educational institutions look at various teaching methods and at other factors affecting learning success, such as math anxiety, gender, previous math experiences, and attitudes of students towards mathematics. Looking at math anxiety is a factor that could be used by counselors in assigning students to the right class.

In order to investigate possible remedies to the current problems relating to math education, it could be important to identify when the student first encountered difficulties and also to identify specific situations that resulted in the problem. According to Handler (Handler, 1988), most math anxiety has its roots in the teachers the students had and in the actual methods of teaching used by the instructors. Math continues to be a subject area of concern in this country. The U. S. Department of Education, in its Goals 2000, has definitely identified math goals that are to be met. Dealing with math-abused students requires that teachers assume additional roles. Teachers are largely responsible

for directing student learning and addressing only the intellectual side is not enough. The emotional side is also a large factor, and the problem of identifying and reacting to those factors is a necessity in the improvement of math education. "Faculty will have to be compassionate enough to help students work through their frustrations but show enough tough love to encourage them to become independent thinkers and help them realize that sustained effort is necessary to master the material" (Cohen, 1995).

The Purpose of the Study

The study was designed to be a case study of mathematics students enrolled at Clovis Community College, New Mexico. This is a college of approximately four thousand students located in a remote region of New Mexico. New Mexico's population is primarily Hispanic, Anglo, and Native American, and the majority of the students are adults with an average age of thirty-six years. The majority of the students at Clovis Community College are also females. In interviewing students, many do not feel that they are prepared for college math and new courses are being developed below the current level to address the needs of these students. In order to meet the needs of the students, the research was conducted in a manner that could identify factors that seemed statistically significant in measuring the attitudes of these students towards mathematics and to examine possible changes in placement of students based on what this project found to be pertinent identifiers of potential math failure. This research hoped to establish a multiple regression model that can use significantly correlated factors to identify those students most likely to experience math failure due to math anxiety. In this research the following questions were answered:

1. Do males feel that they are better prepared by private or public school than females to take math classes at Clovis Community College?
2. Does gender bias appear to exist in the teaching of mathematics at Clovis Community College?
3. Based on sample responses, do more females than males feel that they have experienced a bad teaching experience that resulted in their present level of math anxiety?
4. What differences exist in the female's perception of their math teachers' effectiveness in the past as compared to males?
5. What proportion of males and females in the sample feel that math is their worst subject?
6. Is there a statistically significant correlation between self perceived level of math anxiety and fear of tests?
7. Is there a significant correlation between self-perceived level of math anxiety and gender?
8. Does working in groups appear to lower level of math anxiety?
9. Is the perceived level of note-taking ability related to math anxiety level?
10. Can a multiple regression model be formed for males and for females that would serve as an indicator of possible math placement when used in conjunction with the usual placement test that is normally administered by the college?

In addition, the participants were asked to relate the number of previous high school math classes taken, the number of previous college math classes taken, and the number

of years since they have had a math class. The final question allowed the participant to respond in essay form to whether or not they have ever had an experience that might have caused math anxiety.

The findings of this research should prove useful to the math education in this area of New Mexico. The results of the study will be shared with the math instructors and administration of the college as a tool for possible program improvement in the area of math placement and also instructional methods. The study demonstrated the potential for producing a multiple regression model for the college that can be used as a specific indicator of the potential for success in math and could be incorporated into the placement process.

Definitions of Terms

Math Anxiety. In this study math anxiety will refer to the panic, paralysis, and feeling of helplessness and mental disorganization that arises when faced with a math problem (Tobias 1980).

Test Anxiety. Test anxiety in this research will refer to the panic, feeling of helplessness, and general negative aspects experienced by students when taking a math test.

Self-Perceived Anxiety Level. The level of anxiety that the subject feels she/he experiences on a Likert Scale with one as the lowest level and five as the highest level of anxiety.

Gender Differences. This term will be used to refer to differences that exist between males and females in reference to the study of mathematics.

Gender Bias. This form of bias refers to differences in the treatment of male and female students in the classroom by teachers and also to teaching materials that are slanted in one way or another.

Group Learning. In this study group study shall refer to any classroom or study group activity outside of the classroom in which students work in groups of two or more to solve math problems and define concepts in their own words. This term includes the use of laboratory activities in mathematics.

Math Placement Test. Math placement tests will refer to the tests given by Clovis Community College for the purpose of assigning students to a class. These are administered by the counseling department and are timed tests that only measure skill acquisition in mathematics.

Math Attitude Survey. The survey designed specifically for this study at Clovis Community College. The survey was author designed based on concerns of the math faculty and vice president for instructional affairs.

Limitations of the Study

The major limitation of this study was the narrow focus on one community college. Because the study was a case study of one college, it will not be allowable to generalize beyond this remote area of New Mexico. This study was limited to the math students at Clovis Community College and in no way is a random sample of students from all community colleges. Another limitation was the fact that the sample was drawn from students in three different levels of math classes, which meant that some students had more math experience than others did. However all students were first or second

year students.

Possible confounding variables in this study included the fact that the subjects had been taught by any of three different instructors and the age range was quite large, ranging from eighteen to sixty years. This study did not in any way address the possibility that math anxiety is age related. Another possible confounding variable was subject bias, since the students knew the author and realized that he was doing the research and was also one of their instructors. Experimenter bias could have also entered into the study to a certain degree. Another limitation could be the time of the year the survey was given. It is possible that results might change along a timeline from the beginning to the end of the semester and this was not looked at in this study. The placement test that the students took at the beginning of the semester could have influenced their level of anxiety. Another possible confounding variable was the fact that failure at math can be a combination of things, and this study was primarily examining math anxiety and did not look at things such as scholastic aptitude. The researcher had to be very careful in drawing conclusions.

CHAPTER TWO

Review of the Literature

The Nature of Math Anxiety

There has been an increasing interest in the math anxiety problem over the past few years due in part to the work of Sheila Tobias and her work in this area that began in the seventies and has continued on to the present day. Sheila Tobias was the first to say that the avoidance of mathematics was not a failure of intellect, but instead was related to a failure of nerves. Her original book, published first in 1978 and titled Overcoming Math Anxiety, was revised and published again in 1993. This work has triggered a large amount of study into the existence and nature of math anxiety. Most people remember their encounter with math anxiety as an experience in which they suddenly thought that they could never go any further in mathematics. After that thought, no amount of reassurance or instruction could change their thought that they had reached their peak level in mathematics (Tobias, 1993). When math anxiety sets in, a person does not usually ask more questions, but instead they ask no questions at all for fear of being found out; they begin to fake math skills pretending to know what is going on. According to Mitchell Lazrus they feel like "math Frauds" (Lazrus, 1974).

Many people view mathematics as a punishment that induces instant stress (Zalavsky, 1999) or something that induces that feeling of "sudden death" (Tobias, 1993). The people suffering from this malady believe in their own mind that everyone in the classroom knows that they do not understand and so the problem continues to worsen because they closely guard their secret that they do not understand math.

Mathematics anxiety is more than a simple dislike of mathematics. Smith (1997) characterized the syndrome in a number of ways including: (a) a general uneasiness when asked to do math problems, (b) avoidance of math classes until the last moment, (c) feelings of physical illness, faintness, dread, or panic, (d) inability to perform on a test, and, (e) utilization of tutoring sessions that provide little success.

Possible Causes of Math Anxiety

Math anxiety often arises from a lack of confidence when working in any situation that involves mathematical skills. Some people think that they inherited math anxiety and a lack of mathematical ability from their parents. This of course is a false belief, but widely held. Other factors contributing to the false beliefs about math ability include gender and ethnic background, which have nothing to do with mathematical competence. However, the fact that some people believe these falsehoods can trigger anxiety responses in people who belong to one of those categories.

Another factor is the attitude of teachers and peers to persons of certain ethnic groups and gender (Tobias, 1978). Vanessa Stuart, a fifth grade teacher from Lubbock, Texas, maintains that math ability is ninety percent confidence and ten percent ability (Stuart, 1991). Almost all researchers agree on the fact that most math anxiety is related to a bad experience with a teacher in a math class. When students are asked to respond to what were good experiences with math, they usually stated that teacher praise, good grades, awards, and overcoming a difficult math problem were very good experiences. On the other hand, when asked about bad experiences, students usually list criticism from the teacher or peers and failure.

Another factor to be considered is the attitude of the parents of students of mathematics. While ethnic background and gender do not relate to math ability, they nonetheless enter into the picture through attitude. For example, if the parents of a student feel that girls have no need for math then that idea will be in the mind of the child and become a belief through tenacity. Many families believe, even today, that certain jobs are for girls and certain jobs are for boys. If the pattern is not broken those ideas continue from generation to generation. For example, gender role attitudes in U.S. society, schools, and Latinó families contribute to performance. Stereotypes of Hispanic girls as submissive underachievers are often reinforced by family, school, and media (Deleon, 1996). According to Tinajero, Gonzales, and Dick (1991), Latina mothers exert powerful influences over their daughters' education and career choices. Most daughters are not talked to about post-secondary education.

According to Barbara E. Gallo (personal interview), when she was in grade school and could not do math, she hid this fact by always remaining silent for fear of ridicule if anyone found out she could not do the math or read or write. Therefore the problem got steadily worse until finally it was discovered in the fourth grade by a teacher who then had Barbara assessed and remediation was put in place. Once the problem was out in the open then Barbara was able to learn math. She contends that fear of failure is the driving force in keeping math anxiety hidden from fellow students and others. When she started college after being away from math for a number of years, she found that she had regressed to her original state of fear of math. This student related that she had no support at home for school. Barbara is of Italian, New York City descent and feels that the attitude of Italian mothers is similar to that of Hispanic mothers.

As another example, the following is an actual essay written by a female student at Clovis Community College regarding her math education:

> Hello, my name is (Student Name Omitted). I am currently a returning student.
>
> It has been seventeen years since I first attended college. I am the mother of the three most gorgeous boys you have ever seen. I am married going on nine years. My husband and I decided to raise our boys until they entered school. We believe education to be important, but also raising and nurturing a family is more important. My current major is Spanish. I want to serve as a facet so that kids can learn and enjoy learning while having support, encouragement and the love that each human requires. My math background is limited. I believe while in high school, I adopted an attitude of ignorance for math. In Algebra, I could not understand the formulas and reasoning, so in order to avoid flunking I dropped out. I feel that I am capable of learning math but I need more reinforcement or a different logic than most. My desire would be to learn how to reason math and not fear the subject itself.

In a 1995 study, Kenneth Bessant conducted a factor analysis on 173 introductory statistics students using a version of the Mathematics Anxiety Rating Scale (MARS) and the Study Process Questionnaire (SPS) and was able to identify six factors that are of interest. They were general evaluation anxiety, everyday numerical anxiety, passive observation anxiety, performance anxiety, mathematics test anxiety, and problem solving anxiety. This study suggested that just identifying the existence of math anxiety might not be enough and that the identification possibly should be broken down further to exact types of math anxiety.

Math Anxiety and Gender

According to Gavrielle Levine (1995), before we can deal with math anxiety we must first be able to recognize its presence and try to identify the factors associated with it. The complex factors that must be dealt with include both social and motivational factors that make it more prevalent among females. Males and females appear to perform

and participate equally in mathematics up to adolescence. From that point on girls seem to begin to exhibit less confidence in their mathematical ability. At the Algebra II level it high school, the enrollment differential shows up because this is usually when the student first has a choice about taking math. Performance differences seem to exist between males and females on problem solving, but the difference is very small and has definitely shown a decline over the past twenty years (Inn, 1989).

Research over the past decade indicates that males and females in the same classroom have totally different experiences due to differences in perceptions and learning styles. Another factor in the classroom is that teachers seem to treat males and females differently. Achievement expectations for females in math are lower than for males. The same is true for certain ethnic groups. A study of twelfth grade girls revealed that in all but three countries, girls were less successful than boys in mathematics (Hanna, Kundiger & Larouche, 1990). It suggested that the decline of female achievement is the result of a strong pattern of socialization to mathematics success or failure rather than to gender differences in innate ability. Historically, the adage "math is not for girls," and the belief that girls should not reveal their intelligence, lest it compromise their desirability, have combined to squelch girls' interest in some situations.

When most teachers are asked if they show differences in how they respond to female and male students, they usually indicate that they demonstrate no difference. However, researchers have consistently found teachers to show different behaviors when responding to one sex or the other. This is an area where great progress can be made since teachers have control of their own actions (Sadker et al., 1991).

Another factor that seems to have a detrimental effect on females is the use of-

programs that use tracking. Unfortunately, teachers seem to recommend high-ability girls much less often than boys for advanced placement in math classes. This just seems to reaffirm the possibility that the main factor in math anxiety is teacher related (Krupnick, 1985).

The under-representation of women in mathematics-related careers has long been an issue of equity and has serious economic consequences for the country. The United States suffers a shortage of mathematically trained people and the implication is that forty-nine percent of the work force is female, but females comprise only twenty-four percent of the mathematicians in the country. Future demands for persons with math skills have prompted a national effort to deal with the large difference in males and females employed in jobs that require math. The problem of math anxiety is being addressed because it is thought by many to be the cause of the shortage of females in math. If present demands continue, more females must enter into math related jobs to meet the needs of the country (National Science Foundation, NSF, 1988).

Claudia Zaslavsky (1999), in Fear of Math, sets forth the theory that regardless of social class, racial or ethnic origin, or gender that all students possess some mathematical knowledge and all have the ability to perform adequately. In her book, she identified parent expectation as the most important factor in determining one's potential for success in mathematical endeavors. She also cited poverty as a major factor and feels that it is a much more potent factor than gender could ever be. She cited the fact that peer pressure is a psychological re-enforcer to the notion that " boys do better in math," but she felt that gender was not the major factor. However, she cautions that any unsubstantiated beliefs that math ability is related to gender is a definite cause of the shunning

of math by some students if the student holds such beliefs.

Learning Styles

Learning style differences have long been a recognized factor in the learning of all subjects. Zaslavsky (1999) addressed the different learning styles and noted that if the learning style does not match the teaching style, problems arise. She cited the case of a student who always thought that math problems had to be worked quickly and because this student could not work problems quickly, she developed a strong fear of math. Finally a math teacher recognized that this student learned differently and the fear was resolved. The factors cited by Zaslavsky, in the latest revision of her book Fear of Math, that are to be considered in learning style recognition include:

1. Preference for working alone or working in a group.
2. Preference for a competitive or cooperative environment.
3. Preference for oral or for written methods.
4. Manner of tackling a new situation or problem.
5. Reflective style (mulling over a problem) or impulsive style.
6. Speed of work.
7. Persistence in staying with a task.

Need for outside encouragement and reinforcement, or a go it alone attitude.

Spatial, numerical, logical, kinesthetic, or other approaches to problem solving.

Evaluation of Existing Programs for Math Anxiety

In a presentation to the American Psychological Association, Darin Hendel (1977) examined the potential contributions that could be made by a systematic evaluation of mathematics anxiety programs in existence. The program evaluated looked at a program designed especially for adult women who were returning to college. The pool of subjects was composed of sixty-nine females and two males. The program included a diagnostic clinic, special instruction in mathematics, and a support group. Results of the study suggested that the most effective intervention could be one that focuses on the affective component coupled with another that focuses on the cognitive aspect of the problem.

Students that have high math anxiety also tend to show indications of negative attitudes towards their potential for success in mathematics. Programs that hope to change attitudes towards mathematics must come out of an understanding of different learning styles among students. It is known that students learn best when they are comfortable with the situation they are in. Students at the Ringling School of Art Design were rated using the Myers-Briggs type test as being primarily of the intuitive perceiving style. This style is often associated with right-brain learning, which is not what mathematics is usually associated with. These types of students, according to the study (Biller, 1996), could be provided opportunity for active involvement in their own learning through self-learning, group activities, and teacher contact.

Sloan (1997) and associates conducted a study of the effect of a mathematics methods course on pre-service teachers to determine if such courses had the potential for reduction of mathematics anxiety. The study involved sixty-one participants who were

enrolled in a course called Mathematics for the Young Child. The focus of the course was to use manipulative and active approaches to learning. At the beginning of each quarter, the students completed an anxiety scale and again at the end of the ten week quarter. Many students showed a reduction in anxiety through this type activity; however a few students showed more anxiety because they were unfamiliar with the use of manipulatives in teaching math.

Teaching Strategies to Reduce Math Anxiety

The National Council of Teachers of Mathematics has stated that classrooms should be mathematics communities that thrive on conjecturing, inventing, and problem solving that builds confidence in students (NCTM, 1991). The NCTM has developed suggestions to help reduce math anxiety in the classroom. Those suggested practices are paraphrased below:

1. Accommodate different learning styles.
2. Create a variety of testing environments.
3. Design experiences so that students feel positive about themselves.
4. Remove the importance of ego.
5. Emphasize that everyone makes mistakes.
6. Make math relevant.
7. Empower the students by allowing them to have input into their own evaluations.
8. Allow for different social approaches.

9. Emphasize the importance of original quality thinking rather than formula manipulation.
10. Characterize math as a human endeavor.

The NCTM reflects the idea that the classroom teacher is the one who has control of shaping attitudes toward math in the classroom. With appropriate teaching strategies and sensitivity, teachers can reduce or even eliminate the math anxiety problem. Williams (1988) paraphrased a Chinese proverb to fit mathematics:

> Tell me mathematics and I might remember: involve me ... and I will understand mathematics. If I understand mathematics, I will be less likely to have math anxiety. And if I become a teacher of mathematics, I can thus begin a cycle that will produce less math anxious students for the generations to come.

In summary the teacher and her/his methods are the secret to managing and reducing math anxiety. This is an ingrained problem in our education system, and the cycle can only be broken by changing attitudes of teachers first.

The Pioneering Work

Much of the original work in math anxiety was started by Sheila Tobias who published her book, Overcoming Math Anxiety , first in 1978 and then again in 1993. The 1993 version was expanded and revised to include more recent findings pertaining to the subject. Her primary focus was on why adults have a specific disability with mathematics. She and her team set out to prove that anxiety, and not lack of ability, was the problem. In the seventies most people believed that some people, especially females, just did not have a mathematical mind. Certain researchers at the time actually believed that males possessed a so called "male gene" and Tobias took action to dispel that myth

and other myths about the learning of math. At that time and even now many students change majors when they find out that they have to take certain math classes for their chosen degree. There was definitely something that was keeping young women and a large number of men from achieving their intended goals. Many instructors believed that some people were just dumb in math. Tobias and her researchers thought otherwise. Tobias identified four myths about mathematics that are paraphrased below:

Myth 1: Math ability is inherent.

Myth 2: Mathematical insight comes instantly if it comes at all.

Myth 3: Only a few people can actually do math.

Myth 4: Mathematics is a male domain.

Many studies have been done since the seventies and much is now known about math anxiety and gender differences in math education. The role of Sheila Tobias has been to convince women and men that their fear of mathematics is the result of negative experiences with math. In 1989 a national report on math education included the statement that gender differences in math performance are the result of the accumulated effect of sex-role stereotypes in family, school, and society (Tobias, 1993).

The very first math anxiety workshops in the United States were held at Wesleyan College in the 1970's. Other universities such as the University of New Mexico, the University of Utah, and California State University also had courses to deal with math anxiety. The issue of math anxiety is currently being looked at by many researchers, and the understanding is definitely of significant interest to those in math education.

The Kirtland Community College Assessment Plan

One existing plan to deal with math anxiety can be seen in the program at Kirtland Community College . In their basic math course, an additional indicator is used to assess a student's level of math anxiety. Upon entry into the basic math course, students are given an abbreviated form of the MARS (Math Anxiety Rating Scale). If a student scores above one hundred points on the indicator, the student is encouraged to take the CAR 110 course which helps the student cope with math anxiety. During the last week of the course the test is given again. The information from the second test can be used to show whether a student's increased knowledge of math changed his/her math anxiety level. The results of the test are distributed to the student and to the Director of Guidance and Counseling. The results are used to suggest placement of the student. The entire process is overseen by the faculty for Developmental Mathematics. The action used was simple. A student who scored above 100 on the math anxiety test is asked to take CAR 110. CAR 110 is Coping With Math Anxiety. In 1994, eighty-two students took the test with an average score of 92:5. In 1995, sixty-eight students took the test with an average score of 91.6. In 1996, sixty-four students took the test with an average score of 85.9. Unfortunately, standard deviations were not available for this data (Romancky, 2000). However, the high average score indicated that a substantial number of students were in the math anxiety category.

Marilyn Burns: A Math Reform Supporter

Marilyn burns is one of America's foremost and vocal advocators of math reform in our schools. She has written several books on teaching math skills, and has

taught math herself in the classroom.

Marilyn Burns believes that math phobia is a widespread national problem. There are many well-educated, confident men and women in America whose "math anxiety" seriously impacts their everyday lives. Simple, everyday tasks such as balancing a checkbook, and tipping the waitress at a restaurant, seem to overwhelm them. The adults of today did not learn the skills that they needed in the classroom to enable them to have the confidence needed in order to work with numbers without fear or anxiety.

Marilyn Burns' main focus in her book, Math: Facing an American Phobia, was that the teaching methods of yesterday, which have turned out so many math-phobics, need to be revamped and updated to give today's students the skills that they need in order to compete in today's world. We cannot rely on the same old ways of teaching math and still expect to crank out mathematically competent adults. The ineffective teaching methods of our childhood are unacceptable for today's kids. If they were, we wouldn't have the overwhelming numbers of math phobics today (Burns, 1998).

One of the first things that Burns would like to get rid of is the timed test. Even students who know their multiplication tables seem to freeze up at the mention of a timed test. Why do we need to put so much pressure on children that already have enough as it is? In her book, Burns told a story of a young lady, Lisa, who excelled in math until she reached the sixth grade and had to deal with timed tests. She did so poorly on these tests that her teacher made her stay in for recess. The next year, she was taught mathematics by using timed tests and problem solving. She excelled in the problem solving sections but she could not do the timed tests. She gave up and now feels like she cannot do math. Lisa thought that the timed test is what doing math was all about

(Burns, 1998). The truth is that problem-solving skills are really what our children require in order to survive the real world.

Burns next tackled the question of whether or not we should let our children use calculators in school. She believed that many people are convinced that the use of calculators is part of the problem in teaching math these days. Some people think that children use the calculator as a crutch. Marilyn Burns retold the story of a conversation that she had with a man seated next to her on an airplane. He is an engineer that uses computers everyday to help him do his job. In fact, he couldn't do his job with out the computer. And yet, he feels very strongly that calculators should not be used in schools. He believes that kids should be able to do most mathematical problems in their heads, like making change and estimating dimensions, and that the calculator is getting in the way of learning to do this. Burns countered by saying that not enough emphasis is given on teaching kids to think and reason in their heads, without a pencil and paper and without a calculator, which is the reason that kids cannot do a simple thing like make change. She believes that teaching children to do lots of the same kids of problems with a pencil and paper in which there is only one right answer and only one way of reaching it is the problem to overcome. When she was asked by her seat neighbor about how the calculator will help fix the math phobia problem, she was stumped. She finally explained that calculators are not the problem, nor are they the solution to this problem. The real barrier is what kinds of problems that the kids are using the calculators to figure. The real blockade is how math is presented to these kids (Burns, 1998). Like most Americans, she and the engineer could not agree on the calculator issue. It seems to be a very divisive issue among parents and educators.

Burns was taught mathematics by doing arithmetic exercises, not by thinking and working out problems by solving them using all the methods and skills available to them. Her solution is to "immerse children in doing mathematics by involving them in activities, explorations, and experiments, in which they use mathematics and, by so doing, learn mathematical concepts and skills" (Burns, 1998). Her classroom is now full of small groups of children working together to solve a problem in which each child contributes an opinion and a different way of looking at the problem. They also write about problem solving, participate in classroom discussion, and present their own ideas to the class. This is a far cry from the children intently bending over their own papers in silence, while attempting to work out general problems like those of the not-so-distant past.

CHAPTER THREE

Methodology

Overview of the Proposed Study

This study was centered on a case study of a representative sample of the math students at Clovis Community College and looked at the aspects of math anxiety among the sample. The study was needed for the purpose of searching for and finding new and better ways to help the community college student succeed in the required coursework for their associate degree. Many of the students use the two-year degree as a stepping-stone to a four-year degree, which may require even more mathematics. A random sample of fifty female and fifty male students from a selection three different math classes taught by three different instructors was used from a total of three hundred students who were asked to participate if they so elected. Variables to be examined included attitudes toward the following items listed below:

a. Previous school preparation for math.

b. Level of math anxiety.

c. Bad teaching experiences in the past or present.

d. Beliefs about ethnic origin and math ability.

e. Note-taking skills.

f. Relationships of math to other subjects.

g. Use of calculators in the classroom.

h. Effectiveness of teachers.

i. Quality of textbooks

j. Word problems.

k. Problem level with math tests.

l. Attitude that math is my worst subject.

m. Attitude of boys do better in math than girls.

n. Using study partners.

o. Working in groups.

p. Need for tutors.

q. Presenting problems to other students.

r. Gender bias in the classroom.

Additional questions that will be asked in the survey will include the number of years since their last math class, the number of high school math classes taken, and the number of college math classes taken. A final essay question asked if they could recall a particular experience that they feel could have triggered their math anxiety, if they were a math anxious student. The variables listed above were statistically analyzed using the appropriate statistical procedure to determine relationships in math education that exist at Clovis Community College.

Participants

The participants in the study were students from Math 100, Math 261, and Math 113. Math 100 is the lowest level math class currently offered at Clovis Community

College and students were currently placed in this class by means of a math skills placement test.

Math 113 is titled Math for General Education and is normally taken by students who don't intend to take over two math classes, one of which is usually Math 100. Math 261 is titled Math for Elementary Teachers and is taken by all students planning to go into education as a teacher or as and educational assistant. These courses were be targeted by the researcher because these were the students who had demonstrated a great deal of difficulty with math at the community college level. Based on discussions with members of the math department at Clovis Community College and on discussions with the counselors. Participant selection was made by assigning random numbers to each person who filled out a survey and then using a table of random numbers to select the fifty females and fifty males that were actually used in the sample for this study.

Instruments

The students in this research study of attitudes towards math responded to a survey designed by the researcher. The survey instrument used the format of a Likert scale in which students responded on a scale from one to five, with one indicating strongly disagree and five indicating strongly agree. All participation was voluntary and confidential with the full permission of the vice president for instruction granted to the researcher to conduct the study at Clovis Community College. The responses of the students were tabulated for summary statistics of the form: (N, *M, SD*) and the results were used to answer the ten research questions posed by the author in this study. Summary data are displayed in the text for research question. The appropriate statistical procedure

was applied and the data summarized in association with each question. A written summary was prepared and presented with each research question to clarify the significance of the statistical tests applied. The independent variable in this study was the level of math anxiety and gender. The survey form is included in its complete form in Appendix B.

The study in examining attitudes towards mathematics did yield information with the potential for making program revisions based on the information gathered. The study has the potential for incorporating an additional instrument along with the standard placement test. It was thought by the researcher that certain students need to be referred to math anxiety workshops which could be put into effect and the research that was conducted has the potential capability of starting action in that direction.

Procedures

Step one in this research study was to meet with the vice president for instruction at Clovis Community College to secure permission to conduct the study. Once permission had been secured in writing, the researcher met with the math teachers teaching the courses to be surveyed, one of which was the researcher, and the surveys were conducted with the written permission of the students. The students were briefed on the fact that participation was totally arbitrary and their privacy rights were in no way violated as a participant in the study. The Family Privacy Act of 1974 and the rights of subjects as defined in the Code of Ethics as stated by the American Psychological Association were all followed completely. The students were aware of the fact that they were volunteer participants in a study being conducted by the researcher as part of the fulfillment of

the Doctor of Education Degree. The results of the study will be made available to the participants in the study and to the officials of the college. A copy of the proposed Research Consent Form is shown in Appendix C.

The surveys were collected and results tabulated by the researcher. Summary statistics for each survey question were tabulated and include the sample size, sample mean, and sample standard deviation. These summary statistics were then used in accordance with each research question. The tabulated results were separated into two groups, one for males and one for females. All data summaries are displayed. Since there were ten research questions, each question is addressed as a separate subsection of the data analysis section of this dissertation. In addition sample responses from the question that allowed students to identify an event or events that might have triggered their fear of math are presented in the text. These proved valuable since they are direct written statements from students. It is important to note that all of the research questions are designed to present a cross-sectional view of math education by the students of Clovis Community College. The study was be the first of its kind done at this college and did yield quantifiable results that could be used as a tool for improvement of the math department.

CHAPTER FOUR

Results

In this research study, the results will be presented in a format that relates to each of the ten research questions. Each research question will be treated as a subsection and presented entirely with sample description and appropriate statistical procedures for each question. The researcher used the traditional method of hypothesis testing, which involved the use of critical table values that are used to establish cutoff points to determine whether or not the null hypothesis is rejected. All of the tests were conducted at a significance level (alpha) of .05, which meant there was a five percent chance of committing a Type I error: the chance of rejecting a true null hypothesis.

Description of the Sample

In this study there were two random samples. One consisted of the randomly chosen female students and the second consisted of the randomly selected male students from Clovis Community College who were enrolled in a math class during the spring term 2000. The sample size was fifty students for each sample. The participants were selected from a pool of students who fall in the age range of eighteen to sixty. The ethnic composition of the student body is a majority Hispanic and female. The average age student at Clovis Community College is in their late thirties and is most likely to be female. After the initial survey data was collected the sample mean and sample standard deviation for each response on each questionnaire item was computed and placed in a data summary table based on gender. The table also includes a ninety-five precent confidence interval for each question response and an approximate percent of support for

each survey statement. Therefore there were two summary tables. These summary descriptive statistics were then used with the appropriate statistical test to quantitatively answer the research questions of this study. The members of the sample were currently enrolled in one of three math classes at Clovis Community College: Math 100, Math 113, or Math 261. The students in Math 100 or Math 113 were entry-level students and the students in Math 261 were pre-service teacher education students. The Math 261 students were of particular interest because their attitudes towards math could be a factor in the attitudes of their future students.

The software used in the analysis of data included STATDISK (Password Inc.), copyright 1998 from Addison, Wesley, and Longman, and Microsoft Excel.

The sample was described statistically by the following variables: gender, math anxiety level and the students' attitudes towards previous school experience, perceived gender bias, ethnic group, note taking skills, perceived relationship of math to other subjects, calculators, effectiveness of teachers, textbooks, word problems, self perception of math ability, use of study partners, group study, tutors, and presenting problems in front of the class.

In addition the participants were be asked to give the number of years since their last math class, number of years of high school math, and number of college math classes taken. The participants had the opportunity to respond in essay form to a question dealing with any experience they might have had that could have been considered to cause math anxiety. It is a common practice now for students to write an essay entitled "Math and Me" in order to provide them a vehicle for expressing themselves about math concerns and fears. Table 1 shows the summary statistics for the male sample

group.

Table 1

Summary Statistics for the Male Sample Group

Survey Data for Fifty Male Students at Clovis Community College.

Statement	Mean	SD	95% C. I.	%
Public or Private school prepared me for college math.	3.00	1.36	2.62, 3.38	60
I have experienced math anxiety.	4.00	1.38	3.61, 4.38	80
I feel that I have experienced gender bias in math classes.	2.12	1.31	1.76, 2.48	40
A bad teaching experience resulted in my problems with math.	2.54	1.48	2.13, 2.95	50
Certain ethnic groups do better at math.	1.87	1.17	1.55, 2.19	37
My note taking skills are very good.	2.96	1.30	2.59, 3.32	60
Math is not related to other subjects.	1.74	.97	1.47, 2.00	34
Calculators should be used in college math classes.	4.07	1.31	3.71, 4.43	80
Most of my math teachers have been effective.	3.61	1.36	3.23, 3.99	72
Math textbooks are well written.	2.74	1.24	2.40, 3.08	55
I have trouble with word problems.	3.70	1.25	3.35, 4.04	74
I have trouble with tests even when I understand the concepts.	3.02	1.39	2.63, 3.40	60
Math is my worst subject.	3.14	1.55	2.71, 3.57	62
Having a study partner helps me learn math.	3.54	1.28	3.19, 3.90	70
Working in groups helps me.	3.25	1.34	2.98, 3.72	68
I feel I need a tutor when taking math classes.	3.15	1.32	2.78, 3.52	63
I feel that presenting problems in front of the class helps me.	3.15	1.35	2.77, 3.52	62
I have a fear of math tests.	3.09	1.46	2.69, 3.49	60
Years since last math class.	3.60	3.99	2.49, 4.71	NA
Number of years of high school math.	3.00	1.64	2.55, 3.45	NA
Number of college math classes taken.	2.54	1.64	2.06, 3.00	NA

	YES	NO
Have you ever had an experience that you feel caused math anxiety?	62%	38%

Note: The first column reports the mean response of the fifty students on each survey item. The Likert scale ranged from 1= strongly disagree to 5= strongly agree. Therefore a one or two indicates general disagreement with the statement . A three indicates a neutral opinion and a four or a five indicates general agreement with the statement. The standard deviation in column two is the indicator of the spreadability

of the responses; the higher the standard deviation, the greater the spread. The third column gives the ninety-five percent confidence interval, which means that in the long run if many samples were taken that the true mean response would fall within this interval in ninety five percent of the samples taken. The last column reflects the approximate percentage of the students in agreement with the survey statement. Detailed analysis and hypothesis tests appear in the dissertation.

Table 2 shows the summary statistics for each survey item for the females.

Table 2
Summary Statistics for the Female Sample Group

Survey Data for Fifty Female Math Students at Clovis Community College

Statement	Mean	SD	95% C. I.	%
Public or Private school prepared me for college math.	2.86	1.41	2.47,3.25	57
I have experienced math anxiety.	3.84	1.43	3.44, 4.23	77
I feel that I have experienced gender bias in math classes.	1.82	1.14	1.43, 2.21	36
A bad teaching experience resulted in my problems with math.	2.9	1.64	2.45, 3.35	58
Certain ethnic groups do better at math.	1.7	1.05	1.41,1.99	34
My note taking skills are very good.	3.92	1.03	3.63, 4.21	78
Math is not related to other subjects.	1.92	1.16	1.60, 2.24	38
Calculators should be used in college math classes.	4.52	1.07	4.22, 4.82	90
Most of my math teachers have been effective.	1.17	1.33	.80, 1.54	23
Math textbooks are well written.	3.1	1.16	2.78, 3.42	62
I have trouble with word problems.	4.02	1.24	3.68, 4.36	80
I have trouble with tests even when I understand the concepts.	3.34	1.42	2.95,3.73	66
Math is my worst subject.	3.32	1.54	2.89, 3.75	66
Having a study partner helps me learn math.	3.60	1.39	3.21, 3.99	72
Working in groups helps me.	3.56	1.30	3.20, 3.92	71
I feel I need a tutor when taking math classes.	3.08	1.37	2.70, 3.46	61
I feel that presenting problems in front of the class helps me.	3.12	1.53	2.70, 3.54	62
I have a fear of math tests.	3.38	1.43	2.98 ,3.78	68
Years since last math class.	5.03	6.27	3.29 ,6.77	NA
Number of years of high school math.	2.98	.96	2.71, 3.25	NA
Number of college math classes taken.	2.42	1.14	2.10, 2.73	NA
	YES	NO		
Have you ever had an experience that you feel caused math anxiety?	58%	42%		

Research Question Number One

Do males feel that they are better prepared by private or public school than females to take math classes at the community college level?

To answer this question the responses to item one on the survey was tabulated for the fifty males and for the fifty females. The sample size was the same for both and the sample mean and sample standard deviation was used to conduct a t-test for difference of means. The degrees of freedom (n-1) for this t test were forty-nine. For this research question the alternative hypothesis was that the mean for the males was greater than the mean for females and the null hypothesis was that mean for the males was less than or equal to the mean for females. Therefore the test was right tailed. This test was conducted at a significance level of .05, which meant there was a five percent chance of rejecting the null hypothesis when it was really true. The two hypotheses are stated symbolically below:

Ho: Sample Mean for Males $\leq$ Sample Mean for Females.

H_1 : Sample Mean for Males > Sample Mean for Females.

The importance of this question was to determine if there existed a significant difference in how females perceived how they were taught in the past as compared to males. This was examined since some of the literature supported the thought that math classes are more male oriented. The decision rule was that if the test statistic for the two independent samples exceeded the critical value, then the null hypothesis was to be rejected, otherwise the null hypothesis was not rejected. If a difference in attitude was

found as expected then there existed a justification for the school to look at teaching methods that include differences in learning styles between males and females. The results of this test were determined by using a t test for two independent samples. For the males the summary statistics include a mean survey response of 3.00 (SD = 1.36), and for the female sample group the mean survey response was 2.86 (SD =1.41, n= 50) for each group. The significance level of the t test was .05. The computed value for t was .5053 while the critical t value was 1.6449. Since the computed test statistic fell in the fail to reject H_0 region, it was concluded that the sample did not provide evidence that males feel they are better prepared than females for math classes at the community college level.

Research Question Two

Does gender bias appear to exist in the teaching of mathematics at Clovis Community College?

This question was answered with a differential t test in which the mean responses of the male and female groups were be calculated for each of the samples along with the standard deviation. These two groups were independent of each other since males and females did not constitute overlapping groups. The mean response of each group had a value between one and five because that is the range of the Likert scale used in the survey. From these two data sets a t- test for difference of means was conducted. The test statistic was the t statistic and the critical value of t was determined as well as the computed test statistic. The null and alternative hypotheses that were used are shown below:

H_0 : Mean response of Females = Mean response of Males .

H_1: Mean response of Females ≠ Mean response of Males.

This was a two-tailed hypothesis test. The degrees of freedom were forty-nine. The decision rule was that at the significance level of five percent, if the test statistic exceeded the critical value, the null hypothesis will be rejected which would have meant that there was a difference in perceived levels of gender bias between male and female students and that would suggest the need for further study to determine specifically what factors were causing this difference. This was an especially important question since the college has policies in effect regarding unequal treatment of male and female students. The mean response for the female group on this item was a mean of 1.82 (SD = 1.14) for a sample size of fifty females. The mean response for the males was 2.12 (SD=1.31) for a sample of fifty males. The mean response for both groups indicated that there was not a feeling that gender bias was occurring in the classrooms. Surprisingly the mean for the male group was higher than for the female group. The t test for two independent samples yielded a t statistic of –1.2216 while the critical t value was plus or minus 1.96. The significance level was .05 with p = .2219. Therefore the researcher failed to reject the null hypothesis, which meant that there was no basis for differences between the two groups on the factor of gender bias. Therefore gender bias was eliminated as a factor in determining math anxiety levels for the two samples in this study.

Research Question Three

Based on the sample responses, do more females than males feel that a bad

teaching experience resulted in their level of anxiety?

This question was very important to this study because it all detected differences in anxiety between males and females where it existed. It was stated in the form that more females than males experience math anxiety because the past research indicates this is the case. However this research study was a case study and was focused on only Clovis Community College. It was important to find out what the perceived anxiety levels were between males and females and also very important to determine if the perceived levels of anxiety were in fact related to a prior experience of the student that was in fact a negative classroom experience with the teacher. In interviewing students it was found that many can identify the exact class in which their problems first began. At the same time this question also looked for correlation between the anxiety level of the male and female groups and this can be an indicator for the researcher but cannot be classified as causal based on correlation.

In conducting the tests for this question, the first procedure was a differential test between the mean responses of the male and female sample groups. The null hypothesis was that the feeling of a bad teaching experience as causative for the male group was less than or equal to that for the females. The alternative hypothesis was that the feeling of a bad teaching experience for the female sample group was greater than that for the male group. Below are the null and alternative hypotheses for this question:

H_0 : The mean response rating for females $\leq$ The mean response for males.

H_1 : The mean response for females $>$ The mean response for males.

The summary statistics for the female group included a sample size of fifty with a mean of 2.9 (SD=1.6). The data for the males on this survey item included a mean of 2.54 (SD=1.48) . The sample size for males was fifty. The degrees of freedom were forty-nine.

The procedure used on this hypothesis test was a differential test using the t-test to detect significant differences. This was a single tailed (right-tailed) test using the t statistic. The significance level was five percent and the results reported as in the previous t tests in this study. The critical t value in this test was 1.6449 and the computed t was 1.16449. The p value was .1214. Because the computed t did not exceed the critical value the researcher failed to reject the null hypothesis. The sample did not provide enough evidence to support the claim that more females than males attribute a bad teaching experience to their math anxiety.

The second part of the analysis for this question was to look for correlation between the males' level of math anxiety and relation to a bad teaching experience and also to look for a correlation between the females math anxiety level and a bad teaching experience. This test used the standard Pearson r statistic to check for correlation at the five percent significance level. The results of these tests were reported along with correlation coefficients and their possible implications noting that correlation does not imply causation. In this correlation test the null hypothesis was that no correlation exists between anxiety level and a bad teaching experience and the alternative hypothesis was that correlation exists. The symbolic form is the same for both groups and the hypotheses are shown below:

H_0 $\rho = 0$. (No correlation.)

H_a: $\rho \neq 0$. (Significant correlation exists) .

Microsoft Excel was used to compute the correlation coefficients. Critical values for correlation were obtained from Triola (1998) The decision rule in this analysis was that if the computed value of r exceeded the critical table value then correlation existed. Because correlation coefficients can range form –1 to +1, the strength of correlation can be determined by the closeness of the Pearson r to either +1 or –1. Values near zero indicate very little correlation. The critical value for both males and females was ±.2790. If the computed r in either case fell above +.2790 or below -.2790 then the indication was that some degree of correlation existed. The closer the computed value to one or negative one, the stronger the correlation. For the males the computed r value was .2800 and for the female sample group it was .45184. The indication was that for females there is a fairly strong correlation between perceived level of anxiety and a bad teaching experience. This was not true for the male sample. The significance level of the test was .05.

Research Question Four

What differences exist in the in the females' perception of their math teachers' effectiveness in the past as compared to males?

This question was answered by computing the mean and standard deviation on the responses to item nine on the survey form for both the male and the female groups. After computing those two statistics it became possible to conduct a t-test for two independent samples. If the means of either or both samples were high, then the indication

was that perception of past teachers effectiveness was a possible factor to be considered in this study. If the means of the two groups were significantly different, then the indication was that past perceptions of math instructors as a gender factor needed to be examined because there would be an indicator of difference between the sexes. The null hypothesis on the comparison for difference was that there is no difference between male and female perceptions of teacher effectiveness. The alternative hypothesis was that there is a significant difference between the two groups in their perceptions of teacher effectiveness. For the male group on this survey item, the mean was 3.61 (SD=1.36) and for the females the mean was 1.17 (SD=1.33) with a sample size of fifty for both groups. The critical values for this two-tailed test were ± 1.96 at a significance level of five percent. The computed test statistic was 9.0701 and the p value was .0000. Therefore the null hypothesis was strongly rejected indicating that on this factor there was significant difference between the male and female perceptions of a bad teaching experience having occurred at some point in their educational histories.

Research Question Five

What proportion of males and females feel that math is their worst subject?

The summary data showed that sixty-two percent of the males in the sample agreed with the statement that math is their worst subject while sixty-six percent of the females fell into that category. The mean for the fifty males was 3.14 (SD = 1.55) and the mean for the females was 3.22 (SD = 1.54). The researcher conducted a hypothesis test to detect if there was a statistically significant difference in these two proportions at the level of five percent and the results showed that there was no significant difference.

In addition the Pearson r was computed for both the male and female groups at the five percent significance level and the result for the female group was that the calculated r was .66758. This is a very strong indicator of correlation. The critical value was ±.2790. For the male group the calculated Pearson r value was .58218 which was also statistically significant at the level of five precent. The indication here was that there is a very strong correlation between math anxiety and the perception that math is their worst subject for both male and female sample groups.

Research Question Six

Is there a statistically significant correlation between self-perceived level of math anxiety and fear of tests?

This question was answered by conducting a typical hypothesis test using the Pearson r correlation coefficient. The two sets of data for survey question eighteen were used to compute the two sample correlation coefficients as related to question two. The hypothesis tests were conducted for males and females separately. The null hypothesis for each group was that no correlation exists and the alternative hypothesis was that significant correlation exists. The decision rule will use the critical values or the Pearson r as determined by the critical values determined by STATDISK software. If correlation existed for either group then fear of tests could considered as a possible identifying factor in this study. The results of the test for the fifty females produced a correlation coefficient of .71861 and for the fifty male the resulting coefficient was .574264. Both of these results were statistically significant at the five percent level and both showed that fear of tests was to be considered as a possible factor in determining level of math anxi-

ety. The critical value in this test was ±.2790 based on a sample size of fifty for each group.

Research Question Seven

Is there a statistically significant correlation between self-perceived level of math anxiety and gender?

In order to answer this question the two groups male and females were viewed as two separate groups. Using the data from each group in relation to survey questions three and two, a simple correlation procedure was used to determine the correlation coefficient for the male group and for the female group. Again the assumption was that no correlation existed. The results of the tests could be used to establish possible areas of concern for teachers in their classroom methods. If either group of students felt that gender bias existed in the classroom, then appropriate changes could be made by the college to begin remediation of teacher methods and attitudes and elimination of this problem. If the students felt that gender bias was occurring then the faculty and administration could have justification for training in this area.

For the female group the calculated Pearson r was -.05967 with a critical value of ±.2790 and for the males the computed Pearson r was -.05233 with a critical value of ±.2790. The sample size was fifty for both groups. Since the computed value of r for both groups is almost zero we fail to reject the null hypothesis, which was that no correlation exists. This was a very strong statement in the research indicating that gender and math anxiety do not appear to be related in this case study.

Research Question Eight

Does working in groups appear to lower math anxiety levels in males and/or females?

This question was answered by using the mean and standard deviations from the responses to survey item number fifteen. The two samples, male and female were investigated separately. The percentage of each group that seems to favor working in groups was reported and a simple correlation test was performed to see if possible correlation existed between the variable of level of math anxiety and the variable of working in groups. This was done for both groups.

For the males, in response to the statement "Working in groups helps me," the mean was 3.25 (SD = 1.34) and the percentage favoring working in groups was approximately sixty-eight percent. This indicated that a significant number of males felt that group work helped them. For the female sample group, the mean response was 3.56 (SD =1.39). The sample size for both groups was fifty and the approximate percent for the females was seventy-two percent. Clearly the females seemed to value working in groups.

In the question as to whether or not there existed a correlation between working in groups and math anxiety levels, the procedure was to use the variable math anxiety level versus level of agreement with working in groups to determine correlation coefficients for both groups. For the males the Pearson r was .5344 and for the females it was .5644. The critical value was ±.2790 and the test was performed using Microsoft Excel at a five percent significance level. The null hypothesis was that no correlation existed. In both cases the null hypothesis was rejected indicating that correlation existed

between working in groups and math anxiety level.

Research Question Nine

Is the previous number of math classes taken by the student related to the level of math anxiety?

This research question was answered in the following manner. The survey asked the subject to respond to the number of previous classes taken by both high school and college category. Since most of the subjects were entry-level college students, these figures were totaled and considered to be the subjects past math experience factor. For each sample a Chi-Square test of independence was conducted using a contingency table and the Chi-Square test statistic. The assumption was that the row variables, math anxiety level by gender, are independent of the column variables, previous math classes taken. This test was conducted at a significance level of five percent for each of the two sample groups. If the Chi-Square procedure revealed that the variables were in fact dependent, then previous math classes could possibly be considered a factor in math anxiety level of students at Clovis Community College. It was suspected by the researcher that the number of previous classes taken actually increased math anxiety in this region of New Mexico because many of the teachers do not use methods that are considered current and conducive to minimization of math anxiety.

For the males, the test of independence for the row variable, math anxiety level, and the column variable, years of math taken, yielded the following results. The computations were done using STATDISK, which is a supplement to the Triola (1998) statistics textbook. The degrees of freedom for the sample of fifty males were four. The com-

puted test statistic X^2 was 68.772 while the critical value for the test was 11.070. At the five percent significance level and a p-value of. .0000 , the data supported the claim that the rows and columns were not independent . This meant that the rows and columns were related or that years of math taken were related to math anxiety level.

Using the same procedure for the female sample, the computed value for X^2 was 44.074 while the critical value was 9.4877. The p-value was .0000. In the case of the females the data supported the claim that the rows and columns were related.

Research Question Ten.

Can a regression model be formed for males and females that would serve as an indicator of possible math placement when used in conjunction with the usual math skills placement test that would incorporate the factors used in the questionnaire?

This question was addressed with more than one procedure. The regression model was designed to use predicted level of math anxiety as the dependent variable. The factors of the survey that looked promising based on the Pearson correlation coefficients were the independent factors used. These independent variables were entered into the Statdisk program and analyzed using stepwise regression to determine the most promising models for each gender. The decision rule for the stepwise regression procedure was to determine which variables, when included in the model, produced the largest adjusted R-square value. The researcher thusly used the computer to look at all possible models by systematically removing independent variables from the model to see if the adjusted R-square indicator increases or decreases. After arriving at what appeared to be the best multiple regression model, the researcher decided if the model was signifi-

cant, based on the summary statistics involved. If the best model is in fact indicative of math anxiety levels then the model could possibly be considered as a diagnostic candidate for helping students in taking the right class, based on skill level and also on math anxiety level. Any model generated by multiple regression techniques can only be meaningful if the data collected falls with the parameters of the data upon which the model was based. Extreme caution has to be used to make any such claim.

The most promising indicators of math anxiety levels in this case study were:

a. A bad teaching experience resulted in my problems with math.
b. Most of my math teachers have been effective.
c. I have trouble with tests even when I understand the concepts.
d. Math is my worst subject.
e. I have a fear of math tests.
f. Total number of previous math classes taken (this includes both high school and college).

The dependent variable in this procedure was the student's response to the statement "I have experienced math anxiety."

Results Of Multiple Regression for the Males

For the males the dependent variable was Y= " I have experienced math anxiety." As indicated in the survey by a response form one (strongly disagree) to five (strongly agree). The step-wise multiple regression analysis identified (N=50) that the dependent variables to be included in the model that produced the highest adjusted

coefficient of determination were: X_1, "A bad teaching experience resulted in my problems with math "; X_5, "I have a fear of math tests"; X_6, "I have trouble with tests even when I understand the concepts"; X_7, total number of previous math classes taken in high school and college. The model in symbolic form along with its necessary values appears below:

$Y_{male} = b_0 + b_2 X_2 + b_5 X_5 + b_6 X_6 + b_7 X_7$, where :

$b_0 = 4.4092$

$b_2 = -0.017897$

$b_5 = 0.13572$

$b_6 = -0.14821$

$b_7 = -0.050336$

Standard Error = 1.4480

Coefficient of Determination = 0.025538

Adjusted Coefficient of Determination = - 0.62410.

The value of the adjusted coefficient of determination was the statistic of interest because it was the multiple coefficient of determination that was modified to account for the number of variables and the sample size. The other statistic of interest was the standard error of the estimate, which is a measure of the differences between actual data measurements and those predicted by the model. The value of -.62410 represents a fairly strong model but is not without error. Approximately sixty-two percent of the variation in results for the male model was explained by the multiple regression

model.

Results of Multiple Regression for the Female Sample

For the female sample (n =50) step-wise regression procedures led to the acceptance of the following independent variables as those that produced the highest adjusted coefficient of determination when used in conjunction with each other. For the female sample group (n=50), the variables were b_2, "A bad teaching experience resulted in my problems with math"; b_3, "Most of my math teachers have been effective"; and b_6, " I have trouble with rests even when I understand the concepts." The model had the same format as for the males but with slightly different variables as identified above. The Model for the females in symbolic form appears below:

$Y_{female} = b_0 + b_2X_2 + b_3X_3 + b_6X_6$, where

$b_0 = 2.9579$

$b_2 = .20532$

$b_3 = -.26632$

$b_6 = .43567$

Standard Error = .48890

Coefficient of Determination = .75129

Adjusted Coefficient of Determination = .64470

In the case of the multiple regression model for the females the adjusted coefficient of determination of .64470 suggests that the model accounts for approximately

sixty-four percent of the variation.

In both models, male and female, there still existed some unexplained variation, but the models did seem to provide a reasonable platform for investigating the phenomenon of math anxiety in students at Clovis Community College.

CHAPTER FIVE

Summary, Conclusions and Recommendations

The discussions of the results of the study will be presented in a format that addresses each research question along with conclusions and implications for further research.

Research Question One

Do males feel that they are better prepared than females by public or private school to take math classes at the community college level?

The results of the t test for this question were significant in that at the significance level of five percent, the samples (n =50) did not provide any evidence that males feel they are better prepared than females for math classes at Clovis Community College. It was thought by the researcher that significant differences existed in this factor, but such was not the case.

Research Question Two

Does gender bias appear to exist in the teaching of mathematics at Clovis Community College?

The means and standard deviations for the male and female samples were calculated and a t test for two independent samples was applied. The two independent samples, at a significance level of five percent clearly indicated that gender bias in the teaching of mathematics at Clovis Community College does not exist to any measurable

quantity in the samples studied. This was a very important question for this study since the literature review had indicated that gender bias in the classroom is a factor in some studies. However differences did occur in student perceptions of effectiveness of their previous math teachers.

Research Question Three

Based on the sample responses do more females than males feel that a bad teaching experience resulted in their level of math anxiety?

The t-test used here to look for differences was very significant to the study. The means for both groups were very close and so were the standard deviations. The result of the t test was that there was not sufficient evidence to support the claim that more females than males attribute their level of math anxiety to a bad teaching experience. However fifty-eight percent of the females indicated in the study that they agreed that a bad teaching experience had contributed to their math anxiety and fifty percent of the males in the sample identified this item as a factor. In view of similar findings in other studies cited in the literature, the researcher concludes, based on the sample findings, that this is a factor to be considered in studies of math anxiety. Surprisingly, there was almost no difference between the male and female groups on this item. Past research has identified this as a factor in math anxiety and the same thing was concluded in this study. Most students, based on interview and on these survey results, can recall a classroom event that seemed to have triggered their math anxiety. The researcher recommends that students write "Math and Me Essays" in the classes to help them identify the source of their math anxiety.

Research Question Four

What differences exist in the females' perception of their math teachers' effectiveness in the past as compared to males?

Very large differences between the samples occurred on this question. The researcher felt that this question was the one that yielded the most significant results of the study. From the descriptive statistics it was determined that only twenty-three percent of the females (n= 50, M=1.17, SD = 1.33) thought that their previous math teachers had been effective. For the males the percentage was seventy-two percent (n = 50, M =3.61, SD = 1.36). This result poses many new questions that are not answered in this study and demand further research into this area. Does the result indicate that the math teachers are trained to teach males more than they are females? Does it mean that math materials are more male oriented? Past research has indicated that this may be the case. This question definitely warrants the possibility that more work should be done in this area. The research led to the conclusion that this is the highest priority factor.

Research Question Five

What proportion of males and females feel that math is their worst subject?

The study indicated that approximately six percent of the males in this study felt that math was their worst subject (n =50, M = 3.14, SD = 1.55). For the female group the approximate percentage was sixty-six (n=50, M= 3.22, SD = 1.54). This question provides a great deal of insight into the viewpoint of the student at Clovis Community College. Implications for the college could include further study into reasons for this high percentage for mathematics. A possible solution might be to make mathematics

more student-friendly by examining the current curriculum format used in the classrooms by the instructors. Further study into this area is definitely recommended by the data results.

Research Question Six

Is there a statistically significant correlation between self-perceived level of math anxiety and fear of tests?

This question was answered by doing a simple correlation test for the two sets of responses for both gender groups. The results of the correlation test at a five percent significance level produced a Pearson r of .71861, which is highly significant. For the males, the r value was .574264 which was regarded as significant. This result was in line with the thought that math anxiety was definitely related to a fear of tests.

Research Question Seven

Is there a statistically significant correlation between self-perceived levels of math anxiety and gender?

The results of the correlation tests revealed statistically significant correlation coefficients. The coefficients were almost zero for both groups, which would indicate that gender and math anxiety show no relationship or at best very slight relationships. In this case study gender differences did not seem to exist in terms of perceived anxiety levels.

Research Question Eight

Does working in groups appear to lower math anxiety level in males and/or females?

The importance of this question was to be able to recommend the increased or decreased use of cooperative education methods in the classroom. The results were indicative for both groups that working in groups definitely assisted them in lowering math anxiety levels. This study indicates that for Clovis Community College more group type work time should be allowed in the mathematics classrooms. Seventy-one percent of the females thought that working in groups as helpful, while sixty-eight percent of the male sample felt that working in groups was helpful.

Research Question Nine

Is the previous number of math classes taken by a student related to the level of math anxiety?

Here the Chi-Square statistic was used to look for a relationship between the factors of previous math experience as indicated by the number of classes taken and level of math anxiety. The test indicated that there was a relationship between these two factors for both the male and female groups. The data indicated that the more math classes the student had taken, the higher the anxiety level. Further study should be done here to identify possible reasons why. In interviewing students, the researcher found that those students who had taken more math classes often had done so because they had failed classes and had to continue retaking them until they received a passing grade.

Research Question Ten

Can a regression (multiple) model be formed for males and for females that would serve as an indicator of possible math placement when used in conjunction with the usual math placement test that would incorporate factors used in the questionnaire?

The results of the model analysis for males and females produced different results in that possible factors to be included for the male group were not the same as the factors for the female group. The regression models reported in Chapter Four indicate that a large percent of the variation can be explained but by no means can it all be explained. The researcher feels the models are indicative of math placement to a certain degree. However more factors need to be identified since the adjusted coefficients of determination for both groups explained only a portion of the variation. The models could definitely serve a useful purpose as placement supplements.

In final conclusion, this study revealed factors for possible inclusion into the considerations of Clovis Community College pertaining to curriculum development and placement of math students. The study also identified factors that do not need to be considered at this college. While a lot of research has been done on the subject of math anxiety, the author concludes that regional variations in student bodies would almost dictate that a different study be done at each college if the data is to prove relevant. This is an area of many generalizations that do not necessarily apply to all colleges. The researcher, in this study, has identified some of the factors that appear to be pertinent to Eastern New Mexico.

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Appendices

Appendix A

Math Attitude Survey

Math Attitude Survey

Using the scale below with 1=Strongly Disagree and 5=Strongly Agree, please answer to the best of your ability. Circle your response. Check Male or Female

☐ Male ☐ Female

1. Public or Private School prepared me for college math. 1 2 3 4 5

2. I have experience Math Anxiety. 1 2 3 4 5

3. I feel I have experienced gender bias in math classes. 1 2 3 4 5

4. A bad teaching experience resulted in my problems with math. 1 2 3 4 5

5. Certain ethnic groups do better at math. 1 2 3 4 5

6. My not taking skills are very good. 1 2 3 4 5

7. Math is not related to other subjects. 1 2 3 4 5

8. Calculators should be used in college math classes. 1 2 3 4 5

9. Most of my math teachers have been effective. 1 2 3 4 5

10. Math textbooks are well written. 1 2 3 4 5

11. I have trouble with word problems. 1 2 3 4 5

12. I have trouble with tests even when I understand the concepts. 1 2 3 4 5

13. Math is my worst subject. 1 2 3 4 5

14. Having a study partner helps me learn math. 1 2 3 4 5

15. Working in groups helps me. 1 2 3 4 5

16. I feel I need a tutor when taking math classes. 1 2 3 4 5

17. I feel that presenting math problems in front of the class or group would help me. 1 2 3 4 5

Years since last math class. _____

Number of years of high school math. _____

Number of college math classes taken. _____

Have you ever had an experience in a math class that you feel caused math anxiety? _____

Explain:

I understand and agree that my data will be used in a research project.
Thank you for your responses.

Appendix B

Student Research Consent Form

Research Consent Form

To the Student,

I am conducting research at Clovis Community College among the math students in order to develop a composite of the attitudes held by students towards the study of college mathematics. The research involves selecting a representative sample of the math students enrolled in Math 100, Math 113, or Math 261. I will be interested in determining possible factors in your math education as they relate to math anxiety levels among the students.

If you should elect to volunteer as a subject in this study your input will be strictly confidential and the results of the survey will only appear as group data with no reference what-so-ever to your identity. Participation in this study is completely voluntary.

If you decide to participate, please complete the Math Attitudes Survey form. This form uses a scale from one to five and asks you to respond in the form of strongly disagree to strongly agr :, with one representing strongly disagree and five representing strongly agree. Intermediate values indicate varying degrees of attitudes toward the statement.

If you have any questions about the study please feel free to contact me at any time or to come by the office (Phase IV). My phone number is 505-784-7228. If you decide to participate my thanks goes out to you because this study is designed to help the math program a Clovis Community College.

If you agree to participate, please sign the consent form below and hand it in with your questionnaire.

Sincerely,

Richard L. Hendershot

By signing this form I am agreeing to participate in this research study being conducted by Richard L. Hendershot at Clovis Community College. .

_____

Signature

Appendix C

Research Consent Form for Clovis Community College

Research Consent Form for Clovis Community College

To: Dr. Becky Rowley, Vice –President for Instruction
417 Schepps Blvd.
Clovis, New Mexico 88101

From: Richard L. Hendershot
Box 272
Melrose, New Mexico 88124

Dear Dr. Rowley:

In regard to our discussions concerning the study I propose to conduct at Clovis Community College I am submitting a research consent form to you for your approval. The area of interest will be that of math anxiety as it applies to the math programs at CCC. The study which will use the survey responses of fifty female and fifty male students should provide useful information that will help in assessing math students and the overall program. The results of the study will be presented to you for reference in possible program changes. The confidentiality of the students will be maintained in accordance with the Code of Ethics for human research as specified by the American Psychological Association. All participants will be strictly volunteer and records will be maintained in accordance with the Family Privacy Act of 1974 (FERPA).

Thank you very much for your assistance in this research study. By signing below , Clovis Community College approves the research to be done as a case study of the mathematics students currently enrolled .

Sincerely,

Richard Lane Hendershot

Clovis Community College hereby grants approval for Richard L. Hendershot to conduct his research at Clovis Community College.

.....

Dr. Becky Rowley
Vice President for Instruction.